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Diagram Generation Using Genetic Algorithms and Orthogonal Routing

13th RoEduNet Conference – September 2014

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Introduction

- Diagrams are used as a tool to represent data and concepts
- Frequently utilised in software and hardware development
- Computing a proper drawing is a difficult task

Problems

- Complex NP-complete problem
- Classic algorithms have limitations
- Available software presents various drawbacks
- Difficult to satisfy the request of every user

Task Description

- Embedding a graph in the plane
- Ensure planarity, clarity, orthogonality
- Optimize performance
- Allow user customization

Planarity

- Planar graphs have no intersecting edges
- Kuratowski's Theorem defines planar graphs
- Booth-Lueker testing algorithm which runs in linear time

Graph layout

- Traditional methods: grid layout, tree layout, force-directed placing
- Experimental approach combines ideas
- Utilizes genetic algorithms
- Result is more clear and straightforward

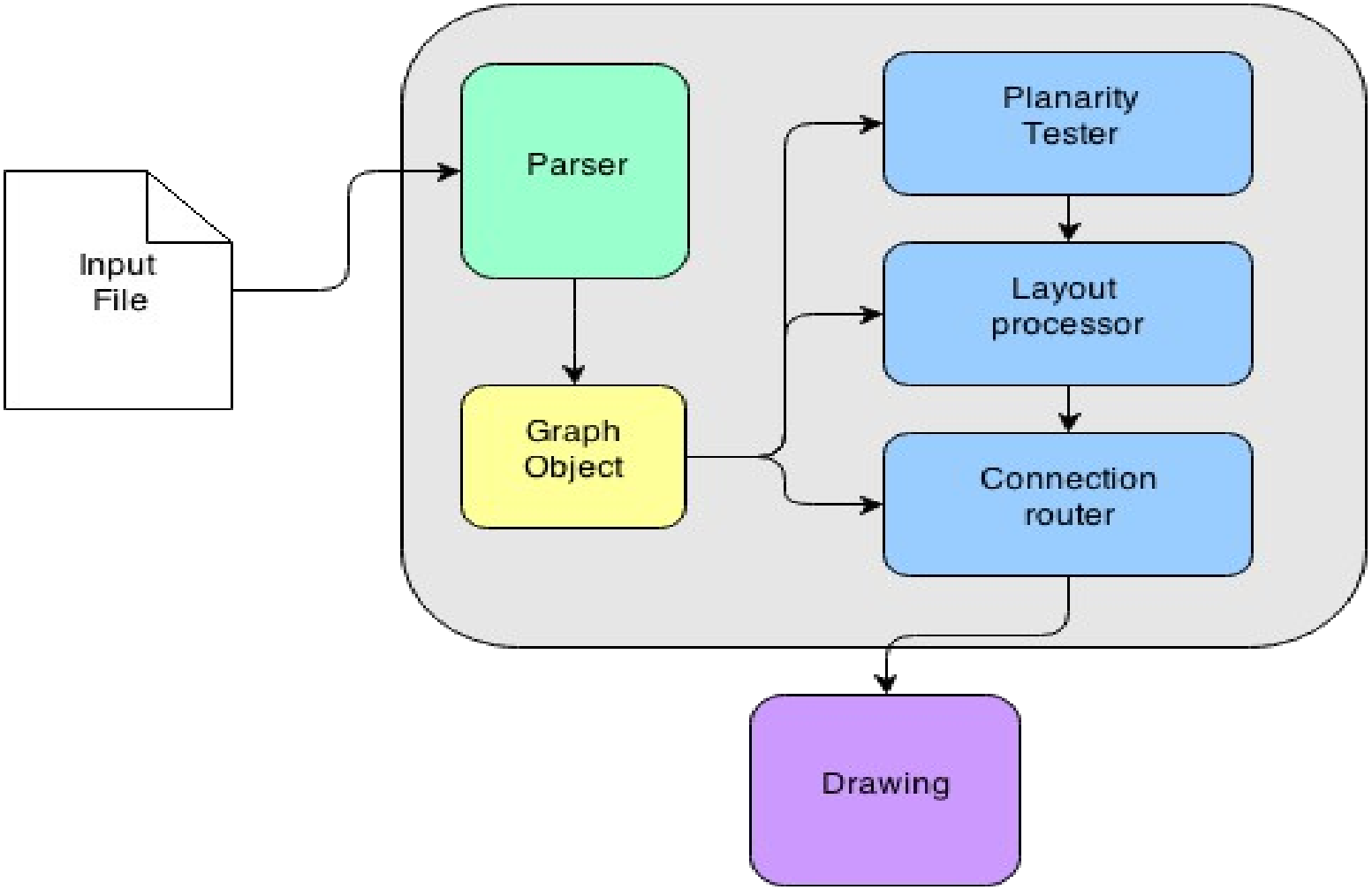
Edge Routing

- Paths represented by orthogonal connectors
- Ensure clarity but occupy more space
- Advantageous for properly layed out graphs

System Architecture

- Four main modules
- Parser computes graph data from input files
- Planarity tester using Chiba-Nishizieki algorithm
- Layout processor based on genetic algorithms
- Edge router with orthogonal connectors

System Design



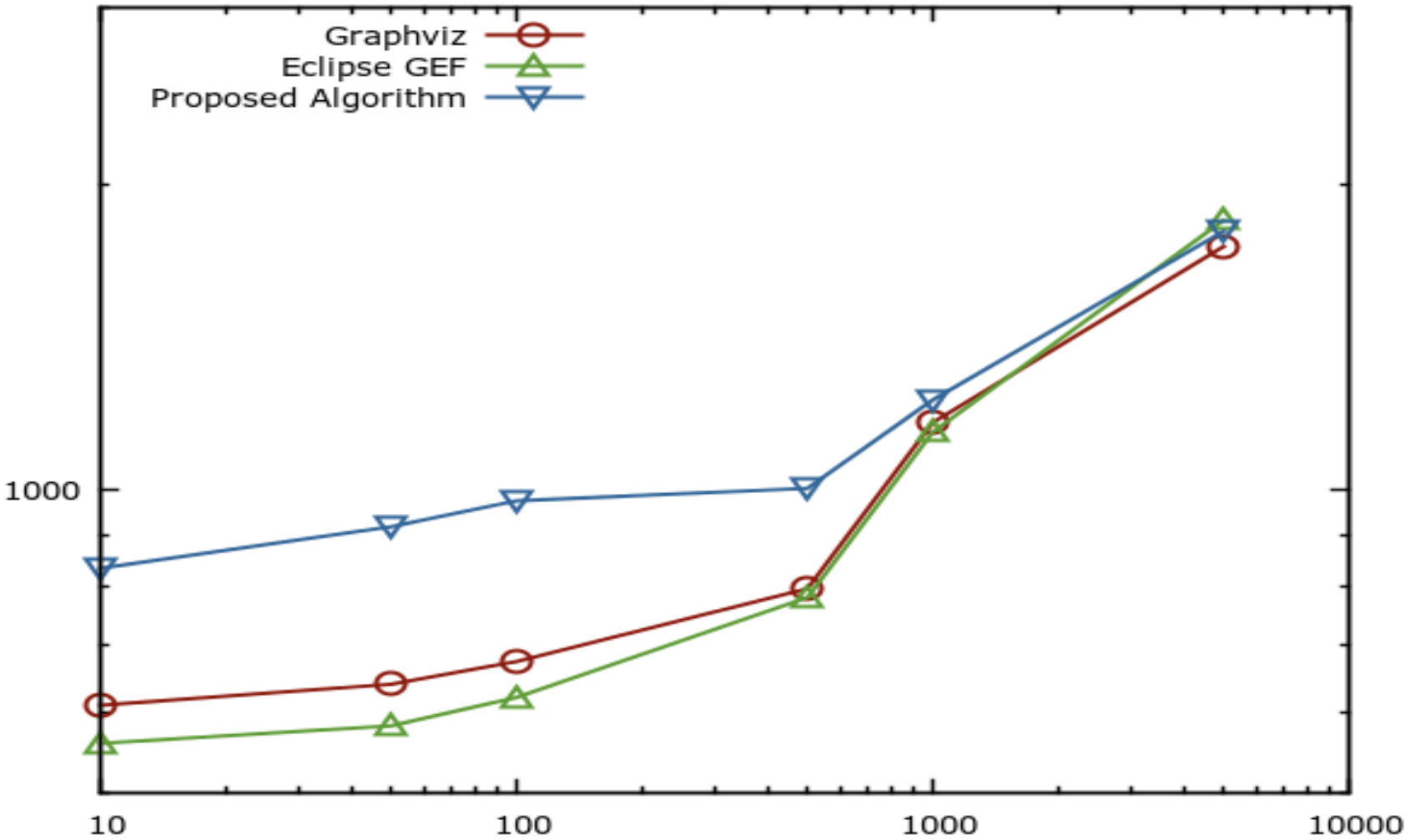
Implementation

- Modules implemented using Java language
- Eclipse Draw 2D used as graphical library
- Application integrated with the Eclipse IDE

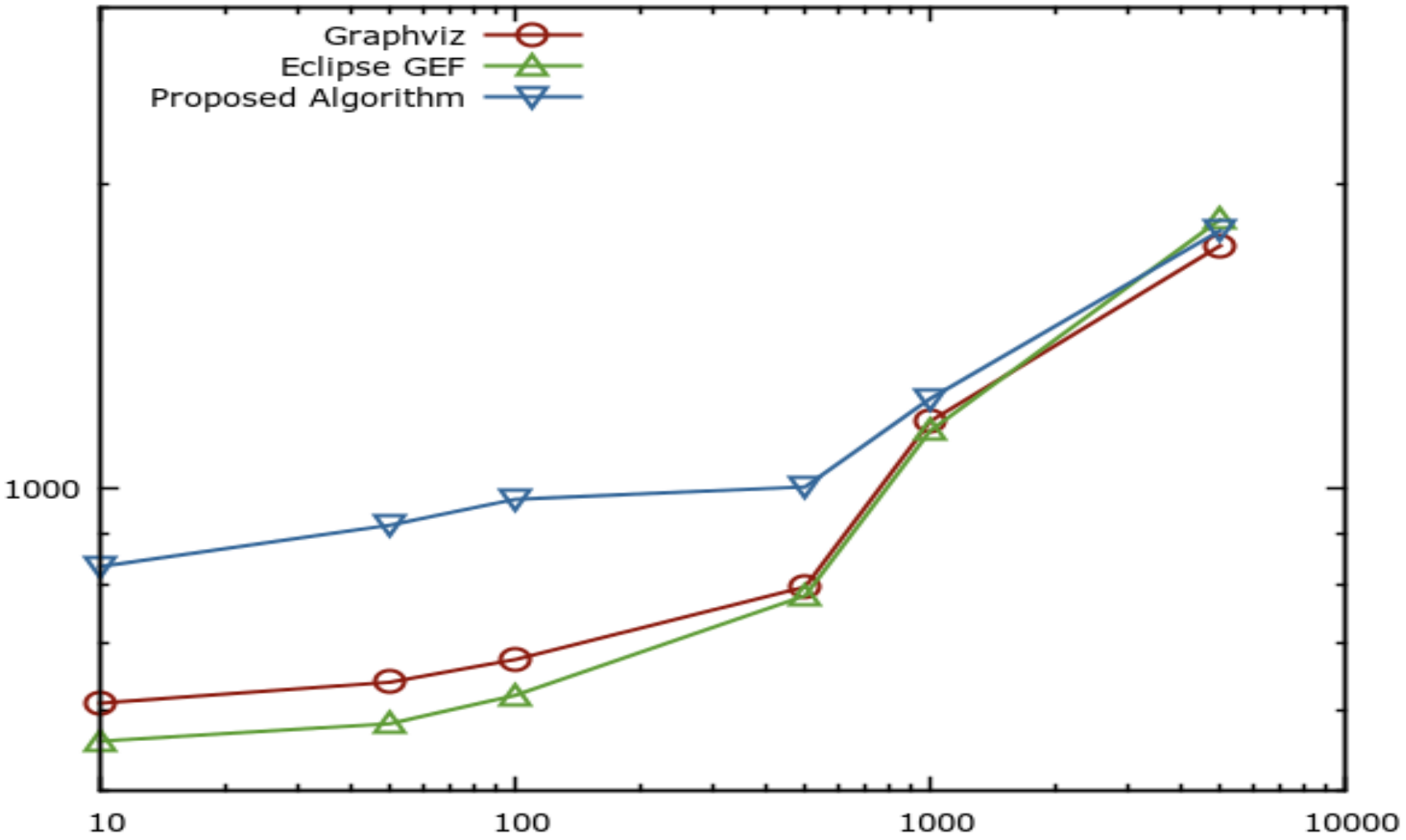
Results - Benchmarking

- Benchmarking for main processing modules
- Available libraries: Graphviz dot and Eclipse Gef used as reference

Benchmark – Small Graphs

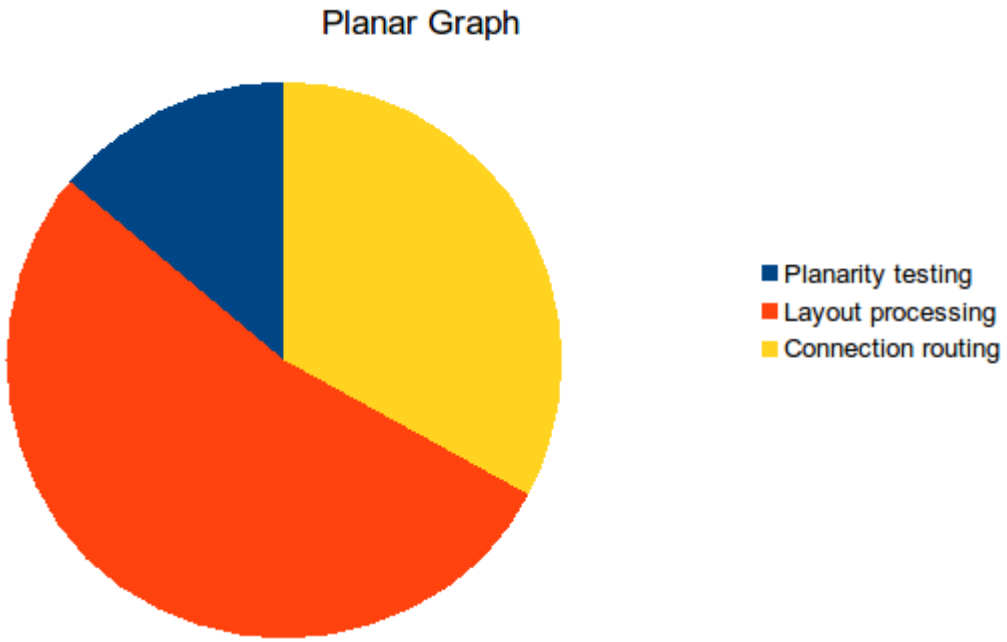


Benchmark – Large Graphs



Performance Testing

- Identify intensively used module
- Possibility for optimization



User Oriented Features

- Interact with final drawing
- Modify position of nodes
- On the fly routing for obstructed paths
- Pin elements

Conclusions

- Modern approach to a classi problem
- Using genetic algorithms helps performance
- Modularisation favours optimization
- Users modifying the result provides insight for further improvements